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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 8, 1879.

SOME NEWER ASPECTS OF CANCER RESEARCH[1]

HAVING spent a good part of the last eight months in Europe among cancer men it appears to me worth while to set down in simple words a few of the things I have seen and heard. What I have to say concerns diagnosis, treatment, biology and causation.

DIAGNOSIS

Diagnosis is easy when the tumor is superficial, but difficult when the tumor is internal, and especially difficult in early stages of growth; yet it is in just these stages that cancer is most amenable to surgery. Any aid, therefore, that the biologist can give to the surgeon is all important for the patient.

Two methods of early diagnosis are now coming into prominence in Europe.

Kotzareff and Weyl, of Geneva, have discovered that if radio-colloidal substances are injected into a cancerous patient there is a selective fixation of the radium in the rapidly multiplying cancer cells. If now a sensitive photographic plate be exposed over the suspected part for some hours, the outline of the tumor is visible on the plate when it is developed. Dr. Kotzareff now at the École medicale in Paris showed me very interesting photographic plates demonstrating this. The only other tissues giving the same or a similar reaction are young embryonic tissues. At present the exact composition of the radium colloidal substances is a secret known only to Mr. Weyl. They are said to be administered in such dilution as to be entirely harmless to man and the experimental animals, a few millicuries only, in serum derived from the patient. More work needs to be done so that the exact composition of these substances may be known generally and the limits of usefulness of the method determined. Dr. Kotzareff needs support for his work and would like to come to the United States.

The other method of early diagnosis is a serum method discovered and perfected by Dr. Botelho, chief of the cancer laboratory of the surgical clinic of Dr. Hartmann in the Hotel Dieu, the great hospital near Notre Dame in Paris, a method on which he has been at work for half a dozen years. It con-

[1] Opening address of the president at the eighteenth annual meeting of the American Association for Cancer Research, Navy Medical School, Washington, D. C., on May 4, 1925.

sists in adding to centrifuged suspect blood serum dilute nitric acid and an iodine reagent in several small doses at short intervals and shaking in a test tube after each addition. Normal serum and that from non-cancerous patients remains clear after the final treatment. That from cancerous patients remains persistently clouded. To obtain the full effect of this reaction all the serums must be reduced or increased to a norm of specific gravity (8 per cent. albumen) as determined on the spectroscope, the dense ones by dilution, the dilute ones by concentration for a short period in the blood temperature oven. When this is done, he tells me, all the normal serums remain clear and all the cancer serums remain clouded. Dr. Botelho was good enough to show me his MS literature and to demonstrate his method for me. Dr. Itchikawa, whom I met in Paris, told me he had tried it on tar cancer of rabbits with confirmatory results.

TREATMENT

Early surgery remains the best treatment for cancer, but radium and X-ray are useful palliatives; and, in case of many superficial cancers, they appear to offer also good chances of long-delayed new growth, if not of permanent cure. It is perhaps too early to speak positively about the latter, the methods are so new, but in various localities some patients have remained well for periods of five years and more following treatment and many for periods of two and three years. In another ten years we shall be able to judge much better of their relative effectiveness in comparison with surgery. At the Madame Curie radium laboratories in Paris Professor Régaud and his associates showed me many interesting things, including numerous photographs of remarkable cures effected, some by X-ray, others by radium. They are there studying intensively the best methods of application, and, on experimental animals, the best dosage. Both radium and X-ray are deadly weapons in the hands of the incompetent. About 500 selected cancer patients pass through their clinics each year, and I was told that 75 to 80 per cent. are cured, but their full records go back only a few years! Prof. Régaud is considered to be the most expert radiologist in France. He is also famous for his studies of mitochondria in animal cells. I saw similar encouraging results two years ago at a clinic in Buffalo at the State Institution for Malignant Disease. Twenty or thirty persons treated by X-ray, one to five years previously, for cancer of the breast, cervix, face, etc., were examined critically by visiting surgeons, who pronounced them to be free from the disease, so far as a physical examination could determine.

PALLIATIVES

Radium and X-ray may also be used as palliatives in the hopeless cases, reducing the pain and the odor. Dr. Botelho in Paris is also treating inoperable cancer of the face and breast with absorbent cotton compresses wet every ten minutes in a mixture of physiological salt solution and glycerine, to which purified tannin, potassium iodide and iodine are added. These compresses are kept on several hours running, night and morning. The cancerous tissue sloughs, all odor disappears, and the normal tissues are not injured. The mode of action appears to be by the formation of precipitates and the constriction or obliteration of blood vessels. I saw one desperate case of breast cancer in which the intense pain had been relieved and the rapid progress of the disease checked. I also saw a letter from this woman's husband expressing the utmost gratitude for her improvement. Up to this time the method has been tried on only a few cases, but on these with very surprising results.

BIOLOGY

In recent years there have been two camps of oncologists, the one believing malignant tumors to be of non-parasitic origin, and the other, a very small minority, of which I have been one, believing that the method of growth in cancer points unmistakably to a parasitic origin. The former have believed the cancer cell to be, so to speak, a normal cell with the brakes taken off, the latter that the cancer cell must be, chemically and physically, an abnormal cell, the driving power of which is some extraneous influence more powerful than the physiological control which normally keeps all the organs and tissues of the body in harmonious cooperation.

If the cancer cells are physically and chemically unlike normal cells it should be possible to demonstrate it experimentally and this has now become an accomplished fact.

Dr. Otto Warburg, of Berlin, has shown by very ingenious and exact methods of experimentation that if grape sugar is present the cancer cells can live anaerobically for a considerable period. Owing to splitting of the sugar during this anaerobic growth, there is an excess of acid produced in cancerous tissues. Normal tissues of animals also produce an excess of acid when they are grown anaerobically, but this acid, said to be lactic acid, they are able to destroy under aerobic conditions so that it can not be found at all, whereas the cancer cells can not do this. In them it remains as an irritant. He thinks, as I do, that the cancer cell not only behaves unlike a normal cell but also contains unlike substances. To a weighed small amount of dry tumor tissue he

adds sodium bicarbonate in serum and from the amount of CO_2 liberated calculates the amount of acid present.

Using the Flexner-Jobling rat carcinoma Warburg has found that, when grown anaerobically in presence of grape sugar, the tumor tissue by glycolysis produces its own weight of lactic acid every eight hours. In a given time, he says, the tumor produces one hundred times more lactic acid than blood, two hundred times more than quiescent frog muscle, and eight times more than active muscle. Tumor sections in sterile Ringer's solution (a physiological salt solution) at body temperature continue to split sugar for days, yet, if such sections are taken after three days and introduced into rats, they give as many cancer takes as fresh tumors. The carcinoma tissue, in other words, behaves like a yeast. If now the tumor tissue be grown aerobically the glycolysis is somewhat reduced, but does not disappear, the respiration of the carcinoma cells being too limited. Embryonic tissue, on the other hand, grown under aerobic conditions in the presence of grape sugar forms practically no lactic acid, its respiration being sufficient to eliminate glycolysis. The metabolism of rat carcinoma tissue in presence of oxygen is, therefore, a mixture of oxidation phenomena and anaerobic splitting, and preponderantly it is the latter, in about the ratio of one molecule of sugar oxidized to twelve molecules split. The epithelium of human carcinoma, grown anaerobically in presence of grape sugar, behaves in the same way, producing each hour about 16 per cent. of its own weight of lactic acid.

"These experiments show *what* happens when a carcinoma arises, but not *why* it happens."

Wir haben uns im Laufe unserer Arbeit die Frage nach den wirkenden Ursachen oft gestellt, und immer wieder hat sich der Gedanke aufgedrängt, dass der "Reiz" bei der Entstehung der Carcinome nichts anderes ist als Sauerstoffmangel.

Warburg suggests that normal resting epithelium is a mosaic in which a few cells are strongly glycolytic, while most are oxidizing cells, and that when for any reason (pressure, sclerosis of vessels, presence of bacteria, etc.) there is a lack of oxygen the nonglycolysing cells perish and the others grow. I was told by Dr. Carl Posener, who demonstrated for me, that sarcoma behaves the same as carcinoma. He said that they had made many tests and that the acid is practically all lactic acid, but I suspect, as does also Waterman, that small quantities of other acids may be present and act as stimulants to cell-division.

Waterman, of Amsterdam, has verified Warburg's results obtained on rats, *i.e.*, the glycolytic action of cancerous tissue on grape sugar with production of a great excess of lactic acid, using, in vitro, a variety of human cancers.

Dr. Russell of London (recently deceased) has also published some data indicating that cancerous tissue (he used that of mice) is able to assimilate certain carbon compounds (some of the pentoses) which normal tissues can not assimilate. If this proves to be correct, here is another way in which tumor cells differ from normal cells.

Some years ago Clowes pointed out that the electric conductivity of tumor tissue differs from that of normal tissue. This has been confirmed by Waterman in Amsterdam and by others. Other differences will be mentioned later when I take up the Copenhagen work.

Five years ago in my text-book on "Bacterial Diseases of Plants" (Saunders, 1920, Philadelphia and London) I propounded the theory that oxygen-hunger is the cause of the abnormal growth in tumor tissue, the rapidity of the cell division depending on the degree of the hunger. The cell breathes through its entire surface and the smaller the cell the greater the respiratory surface, in comparison with the amount of protoplasm to be aerated. It seemed to me under the conditions offered by the crowngall, *i.e.*, presence in the tissues of a parasite producing acid and alkali as the result of its growth, that the cell-respiration must be very thoroughly upset and as a consequence that the tumor cells *must* divide or be asphyxiated. The tissue of the tumor plays a losing game, but it does the best it can under adverse circumstances. I had many observations and experiments that seemed to me to support such a view, but no absolutely conclusive evidence. This we now have, I believe, in Otto Warburg's work. What I advanced partly on experimental, partly on theoretical grounds, he seems to have established experimentally beyond reasonable doubt. If he is right, oxygen-hunger explains the abnormal cell multiplication in tumors.

What leads to oxygen-hunger? According to my hypothesis it was disturbed respiration due to extraneous substances (acids and alkali) thrown into the tissues as the by-products of parasites. These must very effectually upset normal conditions. I conceived the next step to be paralysis or partial paralysis of the surface layer of the protoplasm, the ectoplasm governing outflow and intake, leading to loss of solutes and to an excessive intake of water followed by repeated cell division. However we explain it, the first stage in crowngall, what we may call the precancerous stage, is a decided enlargement

of the cells followed by rapid cell division. This resembles what occurs in animal cancer, as Deelman in Holland has shown conclusively for early stages of tar-cancer in the skin of the mouse. I have examined several hundred of his slides and I am convinced that he is right. If we may believe various reputable workers, the same thing occurs in human cancer. I have summarized some of these opinions in *Journal Cancer Research,* Vol. VII, No. 1, January, 1922.

I believed the excess of acid and alkali produced in flask cultures in the presence of grape sugar by the crowngall organism (*Bacterium tumefaciens*) must also be produced in excess in the tissues of the plant where grape sugar also occurs. This we now know to be the case from our potentiometer studies. In fact, there may be twice as much acid in crowngall tissues as in normal young tissues, tested under like conditions—acid or acids that can not be demonstrated in millivolts interpretable as pH, but which are demonstrable by electrometric titration with sodium hydroxide, *i.e.,* acids locked up in the tissues in the form of salts of ammonia (a substance produced by the parasite in flask cultures and undoubtedly also in the tumors). This coincides very well with Dr. Warburg's findings of an excess of acid in animal cancer cells, only, in crowngall, the acid appears to be produced by the parasite, whereas in the rat-cancer no parasite has been demonstrated, although I believe one exists.

It does not follow from what I have said that the *volume* of respiration of tumors would be greater than that of normal tissues, bulk for bulk, but only that the effort would be greater, as indicated by rapid cell division. As a matter of fact, Warburg has found the respiration in the Flexner-Jobling rat carcinoma to be less than in the normal tissues.

Following the amazing results of tar paintings on the skin of rabbits and mice in recent years, the general trend of medical opinion has been to the belief that cancer is to be explained wholly as the result of chronic irritation, *i.e.,* on Rudolph Virchow's theory. Personally, I believe the pendulum has swung too far in that direction.

Dr. Fridthof Bang, in Copenhagen, has observed cancer in the nose of a man following a single splash of hot tar. He has also produced two cases of skin cancer in mice, slides of which I have seen, by a single burning with the electric cautery. One of these cases developed immediately and the other after one and a half years. In a third mouse he obtained a receding cancer. These observations and experiments lead Bang to believe that Virchow's irritation theory, *i.e.,* the continual long application of irritants to a definite spot, is not the direct cause of cancer. Findlay, in London, has also produced skin cancer in three mice by a single application of hot tar (*The Lancet,* April 4, 1925). I talked with Dr. Findlay, but did not see his slides. He is associated with Dr. Murray, of the Imperial Cancer Research Laboratories in London, and I have full confidence in his work. Dr. Masson, cancer specialist in Strasbourg, showed me slides of a cancer of the thumb which developed two weeks after a man stuck a splinter in his hand, and I heard of a somewhat similar case at the Middlesex Hospital in London, but did not see the protocol. My impression, from what I was told by Dr. Chambers, is that this was in a young person but appeared some time after the reception of the wound.

Dr. Albert Fischer, of Copenhagen, an intensive student of cancer, who formerly worked with Dr. Carrel, has learned how to grow the cells of the Rous' chicken sarcoma out of the body in a pure culture on slides in drops of serum from chicks with a trace of fresh embryo juice added, and from such cultures he has obtained numerous virulent infections, some of which I saw. He has accomplished this by adding a bit of muscle to the serum. The sarcoma cells invade the muscle and destroy it and liquefy the serum, something normal tissues can not do, so that here seem to be other ways in which cancer cells differ from normal cells. In this manner outside of the chicken he has carried along the cell cultures for a period of two years and the last transfers (some of which I examined under the microscope), when introduced into chickens, are as virulent as the cells taken directly from the tumor. This tumor metastasizes so freely and so extensively in vital organs, *e.g.,* the heart wall and the lungs, that it seems impossible a chicken could live so long, riddled with tumors. The work of carrying on the cell-cultures is herculean, since they must be transferred to fresh serum with muscle every second day. He tells me also that a single sarcoma cell will multiply in a culture and invade and destroy the fragment of muscle in a few days, whereas the muscle itself does not grow at all, nor will single fibroblasts grow.

ETIOLOGY

We come now to the causation of cancer, and I will begin with Dr. Rous's chicken sarcoma. It is too late in the day, I think, to deny that this is a malignant tumor, a true sarcoma. All with whom I have talked, *i.e.,* those who have done much work with it, are agreed that it is a true tumor. It will be remembered that the beautiful researches of Dr. Rous proved conclusively that this malignant tumor is due to a filterable virus, that is, to something separable from the tumor tissues and that in consequence the

popular slogan, "the cancer cell is the only parasite," was no longer available to obscure research. It seemed that the "virus" of this tumor must be a living thing, but in spite of enormous labors Dr. Rous was unable to see it or to cultivate it.

Dr. Gye, of the National Institute for Medical Research in London, a student of cancer, of serums and of vaccines, for fifteen years, and for the last two or three years intensely interested in the Rous' chicken sarcoma, has been able to cultivate the "virus" and multiply it in test tubes exactly as we do a living thing, and that, too, through a whole series of tubes of fluid media, and from the final tubes (7th to 9th transfer) he has obtained numerous striking infections in chickens (more than 40). His method is to put 0.02 of a cubic millimeter of the virus into 5 cc of his culture medium, incubate it for three days, then transfer a similar quantity of the fluid to a second tube, incubate that for three days, and so on. The final dilution of the original material, if it were merely a chemical substance, is so great as to be harmless, and the virulence (the active tumor-producing power) in the end term of the series can not be due to a diluted chemical but must be due to a living multiplying organism. Any other explanation is unthinkable.[2] There is, however, no pellicle, precipitate or clouding in these fluid cultures, so far as I could see, nor is anything visible under the highest powers of the microscope; nevertheless, the organism is there, *in a particulate form.* This Dr. Gye has demonstrated by means of the centrifuge. If fluid containing the virus is whirled 9,000 revolutions per minute, and certain other necessary conditions are properly adjusted (I am not at liberty to state what they are), all the virus is thrown down to the bottom of the tube and remains virulent, whereas the previously infectious supernatant fluid has now become harmless as water, but even in the precipitate no organism is to be seen, stained or unstained, by use of the ordinary microscopes. Dr. Gye has also observed another interesting thing, *viz.,* when his cultures become contaminated with cocci and other microorganisms they cease to be virulent. There seems to be an antagonism. He formerly believed malignant tumors non-parasitic, but now he believes very firmly that all or most of them are of parasitic origin. He is full of enthusiasm and believes, as I do, that the solution of the cancer problem is not far off.

[2] Allard has shown for tobacco mosaic and Doolittle for cucumber mosaic that the juice is only rarely infectious much beyond dilutions of 1 to 10,000, as Olitsky has also shown, and such dilutions are surpassed in the second tube of Dr. Gye's series, whereas in his seventh tube in series the dilution is in the trillions and in his ninth tube it is in the quadrillions.

It remained for the physicist, Dr. Barnard, a colleague of Dr. Gye, to demonstrate the organism, using special objectives and monochromatic light. I have been in his laboratory and have seen the body dancing about in the culture fluid (rabbit serum) and also mounted slides of it and photomicrographs of it. It is the same type of germ as the pleuropneumonia organism, but smaller. The latter, seen first by a Frenchman, was described as resembling a yeast, but seen by the subdued monochromatic green-band light of a mercury lamp and with Dr. Barnard's objective of 1.3 aperture, with which he can see down to 0.1 μ, it has none of the characters of a yeast or of an ordinary Schizomycete.

The general method of development of these two organisms, as worked out by Dr. Barnard during the last two years, is to begin as small glistening particles (I saw them under a magnification of 1,800 diameters). These apparently swell up into soap-bubble-like, tiny globes, at least all sizes and gradations of such bodies appear in the fluid. Then, in the surface film, never in the interior, slight thickenings appear, here and there. These thickenings, of which there may be several on a sphere (I saw as many as six or eight on some of the spheres), finally round off, push out into the fluid, remain attached for some time to the periphery of the sphere by a narrow pedicle and then become free, as glistening points, to go through a similar swelling and evolution. I saw nothing resembling a nucleus or a protoplasmic content in any of these bodies.

It would seem to me also from Dr. Gye's work, which is unpublished as yet, that he must have attenuation of the virus in some of his tubes *and a vaccine,* but we must wait for the completion of his studies to know definitely as to this. I saw nothing in Europe more interesting than his work and that of his colleague. More money is urgently needed there for research assistants, and, in my opinion, it could be nowhere expended more wisely. It should be forthcoming abundantly and at once, while these two remarkable men are living and active.

It seemed to me immediately that this work might also throw light on the origin of some of the mosaic diseases of plants, in the cells of which various peculiar and problematic bodies have been observed. I did not then know of Dr. Olitsky's work at the Rockefeller Institute for Medical Research in New York. His studies (*The Jour. of Exp. Medicine,* January 1, 1925) seem to demonstrate that in tobacco and tomato mosaic there is also a particulate multiplying organism and not, as Beyerinck suspected, a fluid contagium, whatever that may mean. I was never able to formulate a clear idea as to what Dr. Beyerinck's "contagium vivum fluidum" could be, but always I

believed and said that the virus of tobacco mosaic would surely turn out to be a microorganism. Olitsky has done for the tobacco mosaic exactly what Gye has done for the chicken sarcoma, and the etiology of mosaic diseases is now in a fair way to be resolved into the presence of parasites in the tissues, just as the logic of the phenomena all along required it to be! Probably with Dr. Barnard's apparatus the organism of the tobacco mosaic can be seen and photographed. It would be worth a journey to London to determine this.

I come now to the work of Dr. Ferdinand Blumenthal and his assistants, Dr. Hans Auler and Miss Paula Meyer, in Berlin. Dr. Blumenthal is the director of the cancer laboratory of the great Charity Hospital on Luisen Strasse and the responsible editor of the *Zeitschrift für Krebsforschung,* the leading cancer journal of the world.

After several years of work they reported that they had been able to obtain from human breast cancers a bacterium in pure culture resembling culturally *Bact. tumefaciens,* the cause of crowngall in plants, and with this organism had been able to cause malignant transplantable tumors in rats and crowngalls in plants. These statements were so surprising and interesting that I went to Berlin and spent about two weeks in their laboratory at the Charity Hospital in order to see as much as possible of their work and to clear up certain doubts raised by the reading of their papers. I was received very courteously. I asked a great many questions and was shown cultures, slides and inoculated plants and animals. Much of my scepticism disappeared on learning exactly how things were done. It is not always possible for a good experimenter to write up his results in a convincing way. That is a special gift. Some of their statements should have been more explicit. I thought I saw various doubtful things in the papers. I was prepared to believe that the rat tumors were accidents, but after being on the ground the only conclusion I could come to was either that the organism from the human cancer is the cause of the rat tumors or else that they are due to some invisible virus introduced along with the heated oedematous cancerous breast serum which was added to the bacterial culture along with the kieselgur (diatomaceous earth) as a second irritant. As for the plant tumors, the organism *PM,* which looks much like the crowngall organism on agar streaks, and is said to behave the same serologically (cross agglutination tests in rabbit serum), not only produced good typical looking crowngalls on sunflowers and other plants two years ago, but is still able to do so. I saw them and brought away specimens and also some of the rats and stained sections of the rat tumors. I counted thirty-two metastases in the lungs of one transplant rat inoculated with *L,* and I have here a rat inoculated with *PM* showing five conspicuous secondary tumors.

Hearing that the Berlin experiments had been repeated in the Aktien Gesellschaft Serum Laboratory Dresden, with the same results, and that an address was to be given on the subject before the Dresden Medical Society, I went down there, heard the address, saw the experiments, talked with the experimenter, Dr. Reichert, and with the director of the laboratory, Dr. Behlke, and most of his associate pathologists. They have done two things in Dresden. They have propagated the tumor *PM* through a long series of rats starting from an implanted rat received from Dr. Blumenthal and they have originated new tumors. I saw a dozen or more of the dissected rats full of secondary tumors. There can be no doubt as to the malignancy of the tumor, and to call it an infectious granuloma does not help matters. It looks to me like a carcinoma. The second thing they have done removes one of my objections to the Berlin work, *viz.,* use of cancer serum as an irritant. Using cultures of *PM* (obtained it will be remembered two years ago from an inoperable human breast cancer) they have produced in rats two metastasizing, malignant, transplantable tumors without the addition of any cancer serum. These had been carried to the fifth and sixth generation of transplants when I was there early in March. The percentage is low, it is true, two cases only out of fifty rats inoculated (the tumors receded in the others), but then we must remember that the organism is in a strange host, and that rats are often resistant to their own tumors. Up to the time of my visit no efforts had been made in Berlin to obtain by breeding a race of rats more susceptible to the bacterial inoculations, but now they will try to do this, at least they promised to undertake it. Dr. Schmorl, the well-known pathologist, in discussion of the Dresden paper, said the structure of the tumor left him in some doubt. He thought the tumor might be carcinoma because so far it has never been found in the spleen (Miltz), whereas the commonest rat-tumor, the rat-sarcoma, is often found there. The tumor is unlike any other rat tumor I have ever seen. The Dresden tumors are like the Berlin ones, and it seems to me very improbable that they should be, all of them, accidental tumors, and yet all of the same peculiar type. The tumor is a diffuse, rather non-typical looking carcinoma, as if it might be a carcinoma plus a bacterial infection, yet in some of the metastases it is a sarcoma. This is not surprising, however, as often in tar-cancer in mice sarcoma and carcinoma appear in the same animal. Dr. Fibiger, of Copenhagen, showed me two metastatic nodules in the lung of a mouse (almost in the same field of the microscope), one a typical sar-

coma and the other an equally typical carcinoma. Polymorphs are numerous, and I think I have made out bacteria in places, but these often occur in rat-tumor transplants. As I have said, the hypothesis that they are pure accidents appears to me untenable and the Dresden work reduces me to one of two alternatives. Either the rat tumors are due to the bacterial culture *PM* or else to some invisible virus attached to the culture and carried along with it. In either event it suggests parasitism. Just as I left Berlin I saw a third rat tumor (good primary, size of the end of my finger, with liver metastasis) produced from a third human breast carcinoma. This is *Beta*. It was just being transplanted, and I have not heard whether the transplants have grown. I showed the rat slides to Jensen in Copenhagen. He said he had never seen any tumor like it. One he pronounced a sarcoma, another from the same rat "possibly an endothelioma."

I found general scepticism in Berlin and in other parts of Europe as to the value of Dr. Blumenthal's work, but it is well to remember that the attitude of medicine toward any startling new discovery has been always one of rank scepticism, which in many cases is only another name for mental inertia. I have learned, therefore, to discount all criticisms which are not based on good opposing work. There are also many jealousies and much misinformation. The cancer laboratory at the Charity Hospital is poor and has urgent need of money for assistants and for additional animals and animal houses. Just now it would be a good place to put money, hoping for interesting definite returns. A few thousand dollars would be of great service and many a rich man who will die of cancer would not miss it in the least and might render a real service to humanity, just as he might also by giving money to the American Association for Cancer Research.

It is the more interesting that Dr. Blumenthal should have reached the conclusion that the crowngall organism is the type of a whole group of cancer parasites, since originally he shared and expressed the opinion of all German pathologists that the American crowngall studies were of no importance whatever to cancer research and only changed his opinion after studying and experimenting with the plant tumor for half a dozen years.

Professor Gosset, the great surgeon of the Salpêtrière in Paris, has also established a laboratory for the study of crowngall and has put Dr. Magrou, a Pasteur Institute man, in charge of it. Dr. Borrel, in Strasbourg, is also now studying it and a great variety of other tumors very actively and has a superb collection of cancer slides. There also a large amount of research is going on upon tuberculosis, syphilis, vaccine virus and all sorts of human and animal diseases. Dr. Borrel has found the cornea of rabbits an excellent place for the propagation of vaccine virus and here by staining methods he had demonstrated the presence of great numbers of cocci, sharply stained (I saw them under the microscope) and closely resembling the bodies he has found in *Molluscum contagiosum*, but from neither disease can they be cultivated. I was much impressed by what I saw in the Strasbourg Medical School. There I was received very courteously and invited to give two lectures to the fourth-year medical students on plant tumors.

Personally, I never thought the crowngall organism could be the cause of cancer in man, but only that cancer might be due to some parasite endowed with similar chemical activities. My reason for disbelief was that, in those strains of the organism which I tested in the thermostat, growth ceased a little under human blood temperature, but always in the back of my thought was the idea that there might be strains of the organism able to grow at 38° C. and for this reason I generally handled the tumors carefully and often sterilized my hands afterward. It was on my mind also to try to educate our strains of the organism to grow at higher temperatures than 36.5° C., but I never found time to try it. I will now try to discover strains able to grow at 38° C.

Looking over the whole field of cancer research I can not resist the feeling that great progress is being made and that the time is not far distant, and perhaps within our own generation, when we shall not only know the cause of human sarcoma and carcinoma, but shall have much better methods of treatment and especially of prevention than any now available. A vaccine is what I hope for and a carrier that may be destroyed, possibly also, a bacterial antagonist. As Pasteur said very often, "The essential thing is to repeat our experiments and not to be discouraged."

ERWIN F. SMITH
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DINOSAUR FEED

THE idea that dicotyls arose suddenly about the time smaller mammals appeared and the plant-eating dinosaurs reached maximum size and widest distribution, has led to some quite unimaginative speculation as to ancient reptilian food habits. With Jurassic hillsides so dominantly clothed in araucarians, pines, ginkgos, cycads and ferns, and lowlands beset by scouring rushes and stoneworts, the food of the great browsing animals seemed limited. Zoopaleontologists suggested, for instance, that terrestrial ortho-

poda, such as Iguanodon and Camptosaurus, ate the cycads and ferns which grew in such profusion during their day as to provide an "ample nourishment"!

Trachodon of the duck-like bill and fine dental battery, was as well equipped for chewing as the Tertiary and later Pachyderms, and was thought perchance to have lived on plenteously associated equisetes, including of course the rhizomes. "The abundant silica of the cuticle would have necessitated just such a formidable apparatus as the Trachodonts possessed for its proper mastication."

Now, in one of the Trachodont "mummies" various twigs of conifers and dicots, needles of *Cunninghamites elegans* and numerous seeds or fruits, all in macerated form, have been found by the German paleobotanist Kraeusel. Hence it is likely that some of the dinosaurs of drier habitats pastured on a severer forage than their relatives of the ox-bows, lakes, meadows and edges of moist warm woodlands with a more varied vegetation.

But the actual ecologic conditions of Jurassic and later time and the greater plant alignments presented a different grazing scene. Soil and climate were as varied as now. From the viewpoint of food as made up of root, stem, leaf and fruit, soils sustained as varied growth of nutrient substances as now. Thus, large edible seeds are abundant from the Carboniferous down, while the specialized vegetation, usually first preserved in the fossil form, rarely indicates the exact food source of contemporary life. In considering the meaning even of Jurassic pines as food it is observed that the pine group was then varied, lush of foliage, numerous in species, perhaps five times as numerous as now, and must have included types quite free from the harsher turpentines characteristic of the specialized limited remnant now seen.

Liliaceous plants abounded in the streams and about the lakes of the Trachodon landscapes, and perhaps added to the reptilian dietary. Tangled masses of water hyacinths, like those that at night in the late winter when in bloom simulate ice floes along the upper St. John's River, may feature the plants on which Como dinosaurs fed. No great animals live on pine twigs, on cycads, on ferns, or on scouring rushes to-day, and it is safe to assert that rarely have any fed to any extent on such arrested, aplastic plants in the past. On the contrary, throughout all Triassic and Jurassic time, the land and water plants closely antecedent to the dicots and monocots of to-day, afforded the varied and abundant food on which the dinosaurs lived and often reached gigantism. Climate was only somewhat warmer, in the geographic temperate zones, with stem structure simpler, and foliage less net-veined. As the dinosauria lived throughout the period of development, of modern stem types and persisted into that of the later dicotyl forests, their disappearance is but indirectly traceable to local loss of food supply due to geologic change. The contemporary plant life as a whole, though not as numerous in species as now, may long have afforded a rather more succulent or more digestible forage than that on which the Indian and African elephant and the rhinocerus thrive.

In all considerations of the food habit of the dinosauria the three factors, climate, habitat, and the prevailing cast of vegetation for the successive periods, must outweigh surmise as to what were precisely the plants on which the particular genus or species lived. Were the hippopotamus only known as a fossil, the habit of feeding on seaweed would scarcely be suspected as one of his aquatic acquirements. While on the other hand the occasional cropping of conifer twigs by the musk ox, and winter season feeding of reindeer on algae are habits of the arctics which have no bearing here, unless showing how far necessity may drive animal life.

Citation of the cycads, particularly those of former desert regions, as a source of dinosaur diet, suggests a further risk of error. Chamberlain, who has seen most of the existing cycads in their habitats, says of the great *Macrozamia Moorei* of East Australia (23° S. L.), so like *Cycadeoidea* in both vegetative habit and the free subapical growth of cones:

> Unfortunately the leaves of cycads contain a poison which has a disastrous effect upon cattle, and in such a place anything green is likely to prove attractive. The cattle eat the leaves, especially the young leaves, and soon show a kind of paralysis which the cattlemen call "rickets." The hind legs begin to drag, giving the animal a peculiar gait, and when it can no longer move about it dies of starvation rather than from the direct effect of the poison. The government is trying to exterminate the plant by poisoning it with arsenic. A notch is cut in the side of the stem, and the arsenic is inserted. The plant soon dies, its leaves droop, and the stem becomes so brittle that the first strong wind completes its ruin. . . . Steps were being taken to create a reservation and thus prevent a plant of such scientific importance from becoming extinct. It seemed nothing short of vandalism to destroy such splendid plants.

If then the dinosaurs toward the close of their long dominance, turned to a cycadeous forage, the cycads could have been one of the causes of their undoing. The gradual development of poisonous principles in the foliage would then have been one of those fortuitous counter-adjustments sometimes seen in nature, tending to survival of the cycadean stock.

Undoubtedly poisonous plants have endangered grazing animals as long as there have been such. Poisonous or deleterious plants must have abounded

always and in all climates, in desert, arid, and wooded regions or plain alike. An enumeration of the more or less poisonous plants of Michigan by Woodcock (*Amer. Jour. Botany,* Feb., 1925) extends to 156 species above the algae and fungi. Most are angiospermous; but as the case may be, either horses, cattle, sheep, goats or people need to avoid three species of ferns, the field horsetail, two junipers, and the American yew. Leaves of all species of oak are poisonous, when forming the sole food of animals. Many of the various species listed yield prussic acid, and the flowers of the "lily of the valley" and the "meadow saffron" toxic honey.

The dinosaur range was more than once narrowed by geologic events; but Africa and South America, half the land area of the globe, always remained tropic. Dinosaurian life having shown no visible sign of failure to adjust itself to relatively modern environments, loss of either food or habitat does not satisfactorily explain the extinction of the entire race; although it is thinkable that time being long, with waning appearance of new species the ordinary course of geologic change would tend to localize and thin out the older numbers.

Nor is it certain that the dinosaurs were as dependent on warmth as is usually assumed. As Lucas suggested, the lungs may have been more bird-like, the blood warmer than in existent reptiles. Moreover the growth rings of the conifers of the Como in any case indicate sharp seasonal change, and there is no known feature of the vegetation in the Freeze Out Hills or of that further north in the Como dinosaurian range, precluding heavy frosts. Whence one must imagine the Como sauropods retreating into the waters of the protected bayous in the colder season, and stretching their long necks to crop the masses of shore vegetation in the springtime; while as the hot dry summer advanced these animals would venture landward into different herbage for egglaying and any care of the young. Other types of medium size like the orthopoda would perhaps hibernate like tortoises about the edges of the low wooded lands.

The really important phase of dinosaurian dietetics must therefore be the comparative odontography measured in terms of present day life and food,—at least with rare exceptions. Plant fossils record only a small percentage of the floras of dinosaur times; while the dinosauria were so varied of structure that they could live in all the terranes of their day from the rivers and lakes to the borders of the plains, and through the shady forests to the edge of the dry desert. Until a greater floral record is revealed in the course of the years, the *menu* of the dinosaur must remain somewhat in the same category as that of Thomas Hood's Mylodon, which was generous, abundant, and only lacked preparation by a modern *chef!* Neither harsh "abrasive" foods, nor thyroid-reactive iodine need be looked upon as elements of dinosaurian diet to any extent. Dinosaurs trampling the earth till the grasses grew is only fair evolutionary phantasy. The grasses may be as old as any larger reptiles.

Not to close this suggestion too hastily it is connoted that the lacertilia afford near views of dinosaur-like food habits. Their habits are most varied, and aside from the many insectivores, larger forms like the Algerian Agamids eat, besides dates, berries, grass and various flowers.

Then amongst the Varanids, the monitors are exceedingly rapacious, at times becoming scavengers. They prey on all animals they can master, and are very active; from which it appears that certain fossil Varanids vieing in size with present day crocodilians, were formidable reptiles which may easily have accounted for some of the past extinction of water fowl and mammals.

More aquatic than any of the monitors, the Galapagos Island Iguanoid, *Amblyrhynchus cristatus,* is semi-marine, feeding on sea weeds below tide. This animal is an expert swimmer. The teeth are trilobate; the head is covered by low conical scales. And herein lies a further suggestion. The famous Maidstone Iguanodon of the lower Greensand might just as readily have led an aquatic life, feeding on sea weeds, as the turtles or an Iguanoid. A few of the armored dinosaurs also suggest algal pasturage. Such are Hierosaurus of the Niobrara chalk and certain allied European types. The marine occurrence of the dinosaurs has never been closely considered. Though of course, such occasional occurrences as that of the Hadrosaurs in the New Jersey Greensand, in the Niobrara chalk, and again in the upper Pierre, may be without bearing on food habits.

G. R. WIELAND

YALE UNIVERSITY

SCIENTIFIC EVENTS

ROBERT SIMPSON WOODWARD

THE following resolution was adopted at the annual meeting of the American Geophysical Union, May 1, 1925:

WHEREAS, We, the members of the American Geophysical Union, have learned with deep regret of the death of our associate, Robert Simpson Woodward, who, after a lingering illness of 18 months, peacefully passed away on June 29, 1924, in the seventy-fifth year of his age, therefore, be it

Resolved, That we express our deep sorrow in this loss of one who took a prominent part in the formulation of the initial plans which led to the ultimate establishment

of this union. Dr. Woodward's contributions to the various branches of geophysics, notably geodesy, are too well known to require enumeration here. He held positions of responsibility, both in governmental and university affairs, and was president of the Carnegie Institution of Washington from December, 1904, to January 1, 1921, when he voluntarily relinquished this position. He was the recipient of many honors, both from universities and learned academies. We cherish the memory of our late fellow member, not alone for his scientific achievements, but also for his sturdy philosophy and ever hopeful outlook.

Resolved, Further, that the secretary of the union be instructed to transmit a copy of this resolution to Mrs. Woodward and that it be spread on the minutes of the union.

LISTER MEMORIAL LECTURE[1]

THE first Lister Memorial Lecture was delivered by Sir W. Watson Cheyne, Bart., F.R.S., on May 14, at the Royal College of Surgeons. This lecture forms part of the memorial to Lord Lister which was decided upon so long ago as October, 1912. Part of the funds raised were devoted to placing a medallion in Westminster Abbey, part to the monument unveiled in Portland Place, London, in March, 1924 (see *Nature,* March 22, 1924, p. 430), and the remainder formed an International Lister Memorial Fund for the advancement of surgery. The Royal College of Surgeons of England became trustees for this latter fund, and it was resolved to award a bronze medal, with a sum of £500, every three years, in recognition of noteworthy contributions to surgery. Sir W. Watson Cheyne is the first recipient of the medal, and the award is particularly appropriate, apart from Sir William's scientific achievements, in that he was, with the late Sir Rickman Godlee, assistant to Lister in London. Sir William's lecture on the occasion of the presentation of the medal was a general account of Lister's aims and achievements, and the full and detailed story is promised in a forthcoming volume. Lister's early work at Glasgow is passed in review, leading up to the time when he learned of the work of Pasteur on fermentation and putrescence. The use which Lister made of this knowledge and the wonderful extensions of the work in surgery caused a revolution in surgical methods, for, as Sir William Cheyne says, "not only has his work led to the practical disappearance of septic diseases after operations, but it has enabled the surgeon to perform many operations which prolong life, restore movements, rectify deformities and add to the usefulness and comfort of mankind." The complete lecture appears in the *Lancet* of May 16.

[1] From *Nature.*

THE SEISMOLOGICAL SOCIETY OF AMERICA

THE directors of the Seismological Society of America, meeting in San Francisco on April 30, elected the following officers to serve during the succeeding twelve months: *President,* Dr. Bailey Willis; *First vice-president,* Mr. H. O. Wood; *Second vice-president,* Captain N. H. Heck; *Third vice-president,* Mr. M. Hall McAllister; *Secretary-Treasurer,* Dr. S. D. Townley. By request of the president, Dr. Arthur L. Day will continue to act as chairman of the scientific committee and Dr. Townley as chairman of the committee on publications. Since both the president and secretary are connected with Stanford University that institution remains the center of administration. The activity of earthquakes in California naturally focuses the work of investigation in that state. The society has, however, broader interests and affiliations with seismological research in general. Its activities are divided between two branches of the subject, scientific research, which it seeks to promote by the publication of the *Bulletin* of the society, and education toward safety, which it strives to advance through the study and discussion of practical measures for safeguarding communities against earthquake damage and conflagration. The membership is now about 650 and is widely distributed throughout the world. All who are interested in matters pertaining to earthquakes are eligible to membership.

S. D. TOWNLEY,
Secretary

STANFORD UNIVERSITY

TRANSFER OF THE BUREAU OF MINES TO THE DEPARTMENT OF COMMERCE

PRESIDENT COOLIDGE on June 4 by executive order transferred the Bureau of Mines from the Department of the Interior to the Department of Commerce, Attorney General Sargent having decided that the action was authorized by law. In furtherance of the same purpose the president some months ago transferred the Patent Office, and other bureaus will be similarly treated when the required legislation is obtained under the reorganization act. Two offices of the Bureau of Mines will remain under the Interior Department, those having to do with coal, oil and other mineral land leasing. These offices, not being engaged in scientific research, under the law can not be transferred.

Secretary Hoover, of the Department of Commerce, said that he soon would appoint a committee representative of organizations of mining engineers and the mining industry to study ways and means to increase the efficiency of the Bureau of Mines and divi-

sions of the Department of Commerce which do work of similar character.

Secretary Work, of the Department of the Interior, in a statement relative to the transfer, said:

The change is one of the reorganization plans approved by the Joint Congressional Committee. The President has a limited authority under the organic act creating the Department of Commerce to make such shifts. It does not apply to other departmental changes which must await Congressional authority.

The primary objects of such segregation are, of course, to secure economy in administration and more efficient relationship with the public.

The Department of Commerce contains a division for service in domestic distribution and foreign trade in mineral products, the Bureau of Mines carried on work of economic character of much the same implication. The Department of Commerce provides statistics of mineral production every ten years—whereas the Department of the Interior provides statistics of mineral production every year and in many cases every month. The Department of Commerce recruits statistics on production of explosives every two years, while the Bureau of Mines procures statistics on their production at regular intervals.

The Department of Commerce carries on research into the strength of wire rope generally for all industries, whereas the Bureau of Mines investigates the strength of wire ropes for the mining industry. The Department of Commerce maintains economic research in use of raw materials for manufacture, a large portion of which are minerals, while the Bureau of Mines investigates the production of raw materials for manufacturing purposes.

Our investigations show that the laboratories of the Department of Commerce carry on scientific research in the use of gasoline and lubricating oils in gas engines, while the Bureau of Mines carried on research generally into gasoline and petroleum products. The research laboratories in the Department of Commerce carry on investigations into the quality of materials for manufacture of porcelain, whereas the Bureau of Mines laboratories carry on research into raw materials for porcelain manufacture. The Department of Commerce laboratories carry on investigation into the qualities of fuel, whereas the Bureau of Mines laboratories tested fuel as to its qualities.

While by constant adjustment, conferences and the appointment of cooperative committees a considerable amount of the actual duplication has been eliminated during the last four years, nevertheless such duplications can not be altogether eliminated and the confusion of citizens in dealing with different government departments for different purposes can not be avoided unless single-headed authority is given for functions having the same general major purpose.

FELLOWSHIPS AWARDED BY THE JOHN SIMON GUGGENHEIM MEMORIAL FOUNDATION

THE John Simon Guggenheim Memorial Foundation, endowed with $3,000,000 by former Senator Simon Guggenheim and Mrs. Guggenheim to furnish funds to prosecute investigation in any field to advanced students of science and learning, has awarded fifteen fellowships. Forty or fifty additional fellowships will be announced next spring. An allowance usually of $2,500 a year during the period of the research goes with each fund. Appointments in the sciences are as follows:

Professor John Robert Kline, of the University of Pennsylvania, for study of the mathematical problem of the "Analysis situs of three dimensions from a point set standpoint," principally at the University of Göttingen.

Dr. Gerhard Krohn Rollefson, of the University of California, for work on the application of the methods of physics to the study of chemical phenomena, principally with Professor Franck, of the University of Göttingen.

Dr. Percival Bailey, of Peter Bent Brigham Hospital, Boston, Massachusetts, and the Harvard Medical School, for research in diseases of the nervous system, principally in the clinic of M. le Professor Claude, at the Asile of Ste. Anne, Paris, and the Laboratory of Dijerine, University of Paris.

Dr. Edwin W. Schultz, of Stanford University, Calif., for a study of the phenomenon of bacteriophagy, principally under Dr. F. d'Herelle, director of the Laboratory of the International Sanitary Council at Alexandria, Egypt.

Professor Coleman R. Griffith, of the University of Illinois, for research in child psychology, principally at the University of Giessen.

INSTITUTE FOR BIOLOGICAL RESEARCH AT THE JOHNS HOPKINS UNIVERSITY

THE Rockefeller Foundation, through its Division of Studies, has appropriated a substantial sum to aid in the establishment, and support for a period of five years, of an Institute for Biological Research at the Johns Hopkins University. This institute will be closely affiliated with the Schools of Medicine and of Hygiene and Public Health of the University. Dr. Raymond Pearl has been appointed director. He will retain a connection with the department of biometry and vital statistics of the School of Hygiene, as research professor in this subject, and will continue as profesor of biology in the Medical School. Dr. Lowell J. Reed becomes professor of biometry and vital statistics and head of the department in the School of Hygiene.

At the outstart the Institute for Biological Research will occupy one floor of the new Hunterian Laboratory of the Medical School. The whole time of the staff, which is now being chosen, will be devoted to research on general problems of biology, but with especial attention to the biology of life duration and its control, and to the experimental study of the population problem.

SCIENTIFIC NOTES AND NEWS

THE degree of doctor of science was conferred on Dr. Irving Langmuir, of the Research Laboratories of the General Electric Company, at the recent commencement of Columbia University.

THE degree of doctor of laws was conferred on Miss Annie J. Cannon, of Harvard College Observatory, on the occasion of the celebration of the semi-centennial celebration of Wellesley College.

DR. JOHN M. COULTER, professor of botany in the University of Chicago since 1896, will retire from active service this month. Dr. Coulter is in his seventy-sixth year.

AT the recent Chicago meeting of the Western Society of Engineers, one of the three Chanute medals for the best engineering papers read before the society during 1924 was awarded to John F. Hayford, director of the college of engineering at Northwestern University, who died a few months ago. The medal was received by his son. The other two medals were conferred on Paul L. Battey and Walter A. Shaw.

DR. EDWARD LEE THORNDIKE, professor of educational psychology in Teachers College, Columbia University, has been awarded the Butler gold medal, given every five years by Columbia University for the most distinguished contribution to philosophy or to educational theory, practice or administration, for his contribution to the general problem of the measurement of human faculty and to the application of such measures to education.

THE University of Manchester has conferred the honorary degree of doctor of science on Professor Arthur S. Eddington, of Cambridge.

QUEEN'S UNIVERSITY, Belfast, will confer the degree of D.Sc. on Professor F. G. Donnan, professor of inorganic chemistry in University College, London, and on Professor E. W. MacBride, professor of zoology in the Imperial College of Science, S. Kensington, both of whom are former students of Queen's College.

DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, has accepted appointment as a member of the advisory board of the John Simon Guggenheim Memorial Foundation.

DR. H. FOSTER BAIN, since 1921 director of the Bureau of Mines, has resigned, to take effect on July 1. He has been appointed chief secretary of the American Institute of Mining and Metallurgical Engineers.

WILLIAM L. BRYANT, for many years director of the Museum of the Buffalo Society of Natural Sciences, has resigned to accept the directorship of the Park Museum in Roger Williams Park, Providence, R. I.

THE fellowship of $5,000 given by the Kahn Foundation for the Foreign Travel of American Teachers has been awarded to Professor Roderick Duncan McKenzie, of the University of Washington, Seattle. Professor McKenzie will spend the next academic year in the Oriental countries bordering on the Pacific to obtain wider perspective of the inter-racial problem.

TO enable him to continue research work on the electro-chemistry of solution, Gosta Okerlof, of Sweden, who was assistant to Professor Svante Arrhenius, has been granted a special Harrison fellowship in chemistry by the trustees of the University of Pennsylvania.

SURGEON GENERAL CUMMINS, of the United States Public Health Service, on June 6 appointed a committee of seven experts to look into the "health hazard involved" in the use of tetra-ethyl gasoline. The committee is to investigate and report to the Surgeon General, if possible, by January 1, 1926. It consists of Dr. David L. Edsall, dean of the Harvard Medical School; Dr. William H. Howell, professor of physiology, Johns Hopkins Medical School; Dr. H. A. Chesley, executive health officer of the State of Minnesota; Dr. Reid Hunt, professor of pharmacology, Harvard Medical School; Dr. Waller S. Leathers, professor of preventive medicine, Vanderbilt University, Nashville, Tenn.; Dr. Julius Stieglitz, profesor of chemistry, University of Chicago, and Professor C.-E. A. Winslow, professor of public health, Yale Medical School.

DR. J. C. ARTHUR, professor emeritus of botany at Purdue University, and Dr. Frank Kern, head of the department of botany and dean of the graduate school of the Pennsylvania State College, who are collaborating in the publication of a book on their researches on rust fungi, will spend the summer in Europe in order to visit specialists in plant diseases. After returning from Europe in the autumn, Dr. Kern, who has received a year's leave of absence, will spend the remainder of the academic year in the University of Porto Rico as acting dean of the agricultural school, where he will conduct researches on the rust fungi and also in tropical botany, plant pathology and agriculture.

DR. WILLIAM H. WILMER sailed on June 2 for Europe to make a survey of research methods, preparatory to the opening of the institute for the study and treatment of diseases of the eye and causes of blindness at the Johns Hopkins University, which re-

cently received an endowment of $3,000,000. Dr. Wilmer will be accompanied by Harold F. Pierce, associate in physiology of the College of Physicians and Surgeons of Columbia University.

DR. JOHN H. GEROULD, of Dartmouth College, will during August visit the Station Zoologique at Wimereux, Pas de Calais, France. After the meetings of the British Association for the Advancement of Science at Southampton, which he will attend, and a month in Normandy, he will spend three months or more at the Laboratoire d'Entomologie, Muséum d'Histoire Naturelle, Paris.

DR. CHAS. E. ST. JOHN plans to sail from Montreal on June 19 for England to attend the meeting of the Committee on Relationship of Solar and Terrestrial Phenomena in London, and later the meeting of the International Research Council in Brussels and of the Astronomical Union in Cambridge.

DR. MAYNARD M. METCALF, chairman of the division of biology of the National Research Council, will conduct researches in Argentina, Chile, Brazil and Uruguay this summer on South American species of frogs.

KIRK BRYAN, of the U. S. Geological Survey, left Washington on June 2 for a two months' field trip in Wyoming, Montana and New Mexico. He will spend about a month at Pueblo Bonito in the Chaco Canyon National Monument for the National Geographic Society.

DR. HERBERT F. BERGMAN, professor of botany at the University of Hawaii, has been granted sabbatical leave for the year 1925–26. He will spend the year at Yale University, as a Seessel fellow, in research work on the proteins of some Hawaiian plants.

DR. IRWIN G. PRIEST, chief of the colorimetry section, of the Bureau of Standards, delivered at the Massachusetts Institute of Technology three lectures on the theory and practice of color specification in science, art and industry May 18, 19 and 20.

DR. A. C. LUNN, professor of applied mathematics at the University of Chicago, recently gave a series of lectures under the auspices of the department of physics of the University of Kentucky. The subjects of these lectures were as follows: "The relativity motive in scientific theory," "The historical background of Einstein's theory and the geometry of space and time," "The problem of the atomic constants and the chemical elements," "Relativity and the quantum theory."

DR. CHARLES LANE POOR, professor of celestial mechanics in Columbia University, lectured under the auspices of the University of Michigan on "Gravitation *versus* relativity" on the afternoon of May 27.

PROFESSOR G. R. WIELAND, of Yale University, gave recently before the Torrey Botanical Club at the American Museum of Natural History a lecture on "The early Mesozoic flowering plants."

DR. F. A. F. C. WENT, professor of botany in the University of Utrecht, is giving at various universities in England a series of lectures under the auspices of the Anglo-Batavian Society. His lecture in London was given at the Imperial College of Science and Technology on May 25, the subject being "Modern conceptions of light stimuli in plants."

THE Lebanon Government of Syria has awarded the Medal of Merit posthumously to Drs. Samuel T. Darling, Baltimore, and Norman V. C. Lothian, of Scotland, who were recently killed in an automobile accident in Syria.

DR. I. MINIS HAYS, widely known as a physician and since 1897 general secretary of the American Philosophical Society, died in Philadelphia, on June 6 at the age of seventy-seven years.

DR. HERBERT S. STEENSLAND, professor emeritus of pathology of the College of Medicine of Syracuse University, died on May 30, aged fifty-four years.

FATHER A. L. CORTIE, S.J., director of Stonyhurst College Observatory, died on May 13 at the age of sixty-six years.

W. W. ROUSEBALL, fellow of Trinity College, Cambridge, known for his work on the history of mathematics and on the University of Cambridge, has died at the age of seventy-five years.

CAMILLE FLAMMARION, astronomer and author of numerous popular works on astronomy, died on June 4 at the age of eighty-three years, in his private observatory at Juvisy, near Paris.

DR. ALFRED C. KINSEY, of Indiana University, writes: "The death of Dr. Karl Sajo of Hungary was reported during the year of 1924. I have a characteristic letter from Professor Sajo, dated April 23, and I am delighted to be able to make this correction. Dr. Sajo has been rendering a good service to American entomologists by offering Hungarian insects for sale, and I hope that the mistaken report has not interfered with his work."

DR. CHARLES W. BURROWS, known for his researches in magnetism, died on May 2, in his fifty-first year, at his home in South Orange, N. J. Dr. Burrows was educated at the University of Michigan. He was formerly head of the magnetic section of the U. S. Bureau of Standards. Later, he became a consulting engineer, in which capacity he worked on applications of the method of magnetic analysis, in laying of the scientific basis of which he had taken a

prominent part. More recently he had developed a system of automatic train control.

WORD has just reached this country of the death of Omer Van der Stricht, professor of histology at the University of Ghent, on May 8, at Menton, France. Professor Van der Stricht had been ill for some time.

THE death is announced of Dr. Sidney Alrutz, director of the Institute of Experimental Psychology at Upsala, and of Dr. Arthur Heffter, director of the Institute of Pharmacology in Berlin.

IN accordance with the wish expressed on behalf of the congress held in 1923 at Oxford, the next International Congress of Psychology will meet in Groningen, Holland, from September 6 to 11, 1926. The congress will be limited, as was the previous one, to about 200 psychologists, to be invited by the committee. The organizing committee consists of Professors G. Heymans, *President;* E. D. Wiersma, *vice-president;* F. Roels, *first secretary;* H. J. F. W. Brugmans, *second secretary;* L. Bouman, G. van Wayenburg and H. Zwaardemaker.

THE twelfth International Physiological Congress will be held in 1926, at Stockholm, from August 3 to 6. Professor Johannson will be president, Professor Liljestrand, honorary secretary, and Professor Santesson, honorary treasurer.

A CHARTER of the Sigma Pi Sigma Physics Fraternity has been granted to Duke University, Durham, N. C. The chapter was installed there on May 14 by a representative from the Davidson College Chapter, Davidson, N. C.

ON May 15 and 16 a conference on geography was held at Clark University at which Harvard, Yale, Dartmouth, Middlebury, Wellesley, Mount Holyoke and Clark were all represented. A series of round-table discussions on the organization of geography work for colleges was conducted. A special paper was presented by Dr. Kirtley F. Mather, of Harvard University; one by Professor Ellsworth D. Elston, of Dartmouth, and one by Professor Phelps N. Sweet, of Middlebury. Professor Wallace R. McConnell, of Miami University, and Dr. Ellsworth Huntington, of Yale University, also contributed to the program. Dr. William C. Alden, of the United States Geological Survey, delivered an illustrated lecture on "The physical features of central Massachusetts," and conducted a half-day field trip for the entire party. On the evening of May 16 Dr. Preston E. James, of the University of Michigan, presented a paper on "A geographic reconnaissance of Trinidad."

THE American Association of Instructors and Investigators in Poultry Husbandry will hold its seventeenth annual convention at the Kansas State Agricultural College, from August 12 to 15. The officers of the association are: *President,* B. F. Kaupp, Raleigh, N. C.; *First vice-president,* Roy E. Jones, Storrs, Conn.; *Second vice-president,* L. E. Card, Urbana, Ill.; *Secretary-treasurer,* L. F. Payne, Manhattan, Kansas.

A NEW honorary society for the promotion of scholarship among advanced students in the veterinary sciences has been organized, being called Phi Zeta. The Alpha Chapter is at Cornell University, the charter members consisting of members of the faculty and the senior class. Dean Veranus A. Moore is president of the society, Professor Howard J. Milks is vice-president and Professor William A. Hagan is secretary and treasurer. President Farrand and Emeritus Professors Simon H. Gage and Walter L. Williams are honorary members.

THE annual meeting of the members of the Royal Institution, London, was held on May 1, when the report of the Committee of Visitors for the year 1924, testifying to the continued prosperity and efficient management of the institution, was read and adopted. The report of the Davy Faraday Research Laboratory Committee was also read. Seventy-eight new members were elected in 1924, and 63 lectures and 19 evening discourses were delivered. Amongst the officers elected for the ensuing year were the following: *President,* The Duke of Northumberland; *treasurer,* Sir James Crichton Browne; *secretary,* Sir Arthur Keith. At a meeting of the members on May 4, Sir J. J. Thomson was reelected honorary professor and Sir Ernest Rutherford professor of natural philosophy.

THE Salters' Company have issued a booklet relating to the Salters' Institute of Industrial Chemistry. The institute was founded in 1918 with the object of giving help in the training of young men for careers in the special industries with which the company is associated. Its functions are, by means of fellowships, to enable young men from universities or other institutions to undergo a special training for industrial chemistry; by grants in aid to enable young men employed in chemical works in or near London to improve their chemical knowledge, and to give advice to persons who propose to enter on careers in chemical industry. The office of the institute, at the Salters' Hall, St. Swithin's-lane, E.C.4, is open daily.

A CORRESPONDENT writes: "A recent letter from Japan reports the destruction by fire on May 1 of the pathological laboratory of the Imperial University of Kyoto. Only a few museum specimens were saved. Professor A. Fujinami, the director of this laboratory, lost much important unpublished material both of his own work and that of his students. Dr.

Fujinami has many friends among the pathologists and parasitologists of the United States. He was a member of the Japanese medical commission which visited the medical centers of the United States in the spring of 1923 as guests of the Rockefeller Foundation."

UNIVERSITY AND EDUCATIONAL NOTES

G. E. MERRICK has donated a tract of land of 160 acres and $5,000,000 toward establishment of a university in Miami, Florida. The university, which was granted a charter on April 5, will be non-sectarian and coeducational. Recitation and study rooms will be built on lines of open pavilions. A $250,000 conservatory of music, $200,000 for the arts department and a chapel have already been assured since the Merrick gift.

THE board of regents of the University of Maryland has approved a recommendation of President Albert F. Woods to appoint Dr. H. J. Patterson, who has been connected with the Maryland Agricultural College since 1888, director of the agricultural experiment station, as dean of the college of agriculture, and Professor P. W. Zimmerman, who has headed the latter department, assistant dean.

DR. ALFRED WORCESTER, of Waltham, has been appointed Henry K. Oliver professor of hygiene at Harvard University, to succeed Professor Roger I. Lee. Dr. Worcester will be also head of the department of hygiene and physical education.

AT the University of Minnesota, Dr. William A. Riley has been appointed head of the department of animal biology, succeeding Professor Henry F. Nachtrieb, who is retiring at the close of forty years of service. Dr. Royal N. Chapman succeeds Dr. Riley as chief of the division of entomology and economic zoology. Both Dr. Chapman and Dr. Riley retain their double membership in the two departments and their work will be closely correlated. Dr. Clarence E. Mickel has been appointed assistant professor of systematic entomology and curator of the insect collection. Dr. Maynard S. Johnson, of the University of Illinois, has been appointed assistant professor of economic vertebrate zoology, and Harvey L. Sweetman, of the Iowa State College, as instructor in economic entomology.

DR. ADOLPH H. SCHULTZ, research associate of the department of embryology of the Carnegie Institution, has been appointed associate professor of physical anthropology at the Johns Hopkins University.

C. L. STEARNS, Ph.D., astronomer in the Yale University Observatory, has been elected research associate in astronomy in Wesleyan University. Dr. Stearns will devote most of his time to observations with the 20-inch telescope of the Van Vleck Observatory in collaboration with Professors Slocum and Sitterly.

AT the University of Colorado, Associate Professor P. G. Worcester has been promoted to a professorship of geology, and Russell Gibson to an associate professorship.

MAJOR K. W. BRAID, assistant in the herbarium, Royal Botanic Gardens, Kew, has been appointed to the chair of agricultural botany in the West of Scotland Agricultural College, Glasgow.

DISCUSSION AND CORRESPONDENCE

THE LABORATORY METHOD IN THE TEACHING OF BOTANY

I HAVE just read in your valued journal an article on William James Beal by Professor Ernst A. Bessey in which occur several historical errors which in the interest of the accuracy of the history of American education should not go uncorrected.

In the opening sentence it is said that the late Dr. Beal "began his botanical studies at a time when the idea of laboratory work by the student of botany was unheard of." Below the middle of the second paragraph it is stated that Louis Agassiz "introduced Dr. Beal to the laboratory method of study, a method not then used at Harvard by either Eliot or Gray." As a matter of fact, William James Beal began the study of science at Harvard in the year 1862–63 and took the degree of Bachelor of Science in 1865. When he entered the university Asa Gray had been teaching botany by the laboratory method for many years to advanced students who sought his instruction, using for the purpose the Botanic Garden and his own invaluable Herbarium. I was in charge of the Chemical Laboratory of the Lawrence Scientific School and had been for more than a year, and my teaching was given wholly by the laboratory method without formal lectures or recitations from books. From the year 1850 on I had been a pupil of Professor Josiah P. Cooke, as a pupil in his own private laboratory, and there was taught by him by the laboratory method only. He also took me with him on his frequent excursions to collect specimens for the Mineral Cabinet of Harvard of which he was the curator—again the laboratory method, though in the field.

In the last sentence of the second paragraph of Professor Bessey's article occurs the following statement: "it was not many years until Dr. Beal introduced the laboratory method of instruction for botany, at a time when this was a startling innovation." Considering the facts, that is a very misleading statement.

Professor Bessey says truly that Dr. Beal "came of Quaker stock and preserved to the end the sterling honesty of action and speech instilled in him by his parents." Therefore, he would certainly wish that the errors Professor Bessey made in the article published by you on May 29, 1925, should be corrected.

CHARLES W. ELIOT

CAMBRIDGE, MASS.,
JUNE 2, 1925

THE METHOD OF SCIENCE

As a counterblast to numerous shocked and grieved allegations of the fundamentalists, various committees and groups of scientists have been issuing apologetic pronouncements, more or less measured in tone, but all alike striving to show that science is innocent of iconoclasm in things religious. And, in line with this, emphasis is laid more and more upon that part of scientific text books which disavows any effect of scientific teaching "to discredit the Bible." The careful report of the committee of California presidents, published in your issue of April 3, 1925, demonstrates this tendency with great clearness. The report itself, incidentally, refers to the "respect and consideration" due to "fundamental principles of religion, as presented in the Bible." Of course, the pressure even of a popular minority is an important factor in democratic control of educational policies: and yet, methinks, they do protest too much.

Am I incorrect in understanding that science is, fundamentally, a matter of method—a process that gains its sanction solely from its ascertainment of positive data and its treatment of these according to a recognized method of rational generalization? If I am not, is it a too reckless thing for scientists to come out openly and stand by their guns, not to defend conclusions but to assert their unqualified faithfulness to the method whereby they derive the only justification for their order in the intellectual life?

The scientist who gives preliminary pledges that his conclusions shall interfere with neither this nor that religion is no whit more reliable than the one who would similarly assure that his conclusions would never upset the complacency of the Nordics, the Vegetarians, the Geocentrists or any other body who have established themselves upon a conclusion which they are bound to maintain, willy nilly, to the bitter end.

Yet if they are not to do this, should they not abandon all this loose talk of religion and gods and Bibles, and frankly admit that, as scientists, they have nothing whatever to do with the matter, since it offers neither the datum nor the concept which is susceptible of treatment or entitled to recognition upon the scientific plane?

And ought not scientists, in committees or in groups as in individual cases, to stand openly forth before all apostles of reaction, whether called fundamentalists or voodoo magicians, and tell them in unmistakable English that the day has passed when truths should be sugar-coated to appease the prejudiced palates of the W. J. Bryans of the day?

For a century plain speaking has been a rarity in the churches. Heaven help us if it depart also from the halls of science.

EDWARD H. DAVIS

WATERBURY, CONNECTICUT

WEATHER CONDITIONS AT SUMATRA

A REPORT secured by Mr. Charles L. Hoover, American Consul at Batavia, Java, from the Royal Magnetic and Meteorological Observatory at Batavia, relating to weather conditions of Sumatra, for the information of expeditions wishing to study the eclipse of the sun in 1926, reads as follows:

The duration of sunshine has been estimated for every hour half from 8 A. M.–4 P. M. in a scale of 0–10, 0 being = entirely overcast, 10 = full record during the half hour.

The mean values express in percentages, are as follows:

Duration of sunshine, from 8 A. M.–4 P. M., in percentages.

	December 1924	January 1925	February 1925
Benkoelen	76	62	61
Palembang ...	48	56	51

In each of the 3 months the percentages of Benkoelen are the higher ones.

For the separate half hours, mean values of the 3 points, the following percentages are obtained:

Duration of sunshine in percentages, December, 1924–February, 1925

8 — 8:30	8:30 — 9	9 — 9:30	9:30 – 10	10 — 10:30	10:30 — 11	11 — 11:30	11:30 — 12	12 — 12:30	12:30 – 1	1 — 1:30	1:30 – 2	2 — 2:30	2:30 – 3	3 — 3:30	3:30 – 4
Benkoelen:															
62	63	65	67	71	72	70	72	70	68	72	70	68	65	57	49
Palembang:															
46	51	56	59	59	59	55	55	49	55	52	56	51	47	41	38
Difference:															
16	12	9	8	12	13	15	17	21	13	20	14	17	18	16	11

During the whole day the average percentage appears to have been 15 per cent. higher at Benkoelen than at Palembang.

These are readings from the records of Jordan's sunshine recorder with sensitive paper, furnished by Negretti & Zambra, London. Of course the probability of a clear sky, as needed for the observation of the eclipse, is smaller than is suggested by the above-mentioned figures, as the sensitive paper yields a record also when there are thin clouds. The data therefore have chiefly a relative value with a view to a comparison between the two places in question.

(Signed) C. BRAAK,
Director
C. G. ABBOT,
SMITHSONIAN INSTITUTION *Assistant Secretary*

CALENDAR REFORM

I SHOULD like to suggest an amendment to Mr. A. L. Candy's revised calendar. I would have in the new calendar the months of January, April, July and October begin with Sunday, in place of Monday.

It is desirable to have the same number of working days in each calendar month. In order to do this it is necessary to start the 31 day months on a Friday, Saturday or Sunday, so that the 31 day months may include five Sundays each, and give 26 week days for every month in the year.

While it would be possible to begin the first day of each quarter with any one of the three days mentioned, it would seem to me desirable to begin them with either Saturday or Sunday, preferably Sunday. By doing so we should have the sequence of Saturday, December 30, New Year's Day, and Sunday, January 1, which would naturally form a three day holiday for almost everyone. In the case of leap years, there would be a similar three day stretch, formed by Saturday, June 30, mid-summer holiday, and Sunday, July 1, This would be a welcome respite for many people who find it hard to get three days together.

In general it is desirable to have holidays come upon Saturday, Sunday or Monday, so they do not break up the working week, and afford the maximum relaxation with minimum interference with business. Where the first day of each quarter begins on Monday, as suggested by A. L. C., only Lincoln's Birthday and Armistice Day come at the week-end, both falling on Monday. But if we start the quarter with Sunday, then we have the above holidays coming on Sunday, which is just as good as Monday because they will be celebrated on Monday, and in addition we have December 25 falling upon Monday instead of Tuesday, which is a manifest addition.

ALVAN L. DAVIS

THE GILBOA FOSSIL FOREST

DR. JOHN M. CLARKE, of the New York State Museum, in an article on "The oldest of the forests" (*The Scientific Monthly*, January, 1921) has vividly described the fossil Devonian Forest (Psarronius) found near Gilboa, New York.

The operations of the Board of Water Supply of the City of New York have uncovered a number of these fossil stumps, and it has occurred to the writer that some, at least, of the museums in the country which have not already secured specimens would like to add to their collections. The work at Gilboa is drawing to a close, and the opportunity of securing specimens will never again be as good as during the present summer season. The number of stumps available is of course, limited. Inquiries may be addressed to the undersigned.

THADDEUS MERRIMAN
2224 MUNICIPAL BUILDING,
NEW YORK, N. Y.

SCIENTIFIC BOOKS

The Life of Sir William Osler. By HARVEY CUSHING. 2 vols. 1442 pp. 8°. Oxford University Press, New York. Price $12.50.

HARVEY CUSHING, one of the most virile and straightforward of living American writers, has very rightly conceived his Osler biography as *mémoires pour servir*. Leaving ultimate appraisal of this great physician's merits to posterity, he has, with secure good taste, taken eulogy (an obituary and lapidary function) for granted, and wisely shunned "the foolish face of praise." Here, indeed, the man Osler speaks for himself, through his clinical achievement, his letters and writings, his thousandfold acts of charity and good-will, his humorous pranks, his unique sense of honor. Hence, where necessary, Cushing has not hesitated to cope with those errors in judgment which Osler himself defined as "mistakes of the head, but never of the heart." The material to be handled was enormous, not so much in the way of letters, for Osler was a poor and telegraphic, if multifarious letter writer, but in the adjustment of the countless minor details of his very busy life to its actual course and tenor. Here all is ordered, documented, controlled as to fact, place and date by accurate footnote references, well indexed, with analytical table of contents and a rubric at the top of each page telling its actual content. In consequence, it is very easy to find one's way about in these volumes. The narrative moves steadily and surely forward, from point to point and period to period. Each sentence states a fact, and we can follow Osler's career understandingly, from the boyhood days in unsettled upper Canada, through the prankish student period

and the subsequent laboratory ardors of the young Montreal professor, to Oxford and the end. Through its commendable absence of eulogy, fine writing and apologetic slaver, the book is thus one of the best of medical biographies, quite up to the standard of Roth's Vesalius in respect of continuity *viâ* documentation.

We gather that Osler was a lively, natural, healthy boy, who set off his Church of England training by the proverbial skylarking of a clergyman's son, even as most of us have been chased by constables and car-conductors, or otherwise hauled up for playing "hookey" *en masse* or smoking out our natural enemies with chemical fumes. Led into biology by the parish priest W. A. Johnson and the unworldly James Bovell, it was natural that the young Osler should turn from university studies and the thought of holy orders to medicine. The ultimate result of these earlier dallyings with microscopy was the description of the thrombocytes and the discovery of *Filaria osleri*. Under the guidance of Dr. Palmer Howard, whose strong face resembles that of Froude, Osler soon became a steady, serious student, consecrated to medicine, and thereafter, his life is one of unparalleled devotion to patients and pupils, diversified by literary labors, some public service, a number of humorous experiences, and such outstanding events as his marriage, the successive calls to Philadelphia, Baltimore and Oxford, and the death of his only son in the war. As a boy, he received instruction in music, drawing and dancing, but in the sabbatical atmosphere of Bond Head and Dundas, these were "parlor accomplishments"; we hear as little of concerts, theater-going, picture galleries and ballrooms in Osler's life as in Jacobi's. His relaxations were the classics, English literature and the history of medicine, in which his scholarship, brought to a fine focus in his address of 1918, was unimpeachable. Although badgered not a little in youth as to the exact shade of his orthodoxy, an inquisition as deadly as disputing degrees of gentility, he weathered it all with the serenity of Peter Pan facing Wendy's poser as to the nature of his matrimonial intentions. In practical joking, Osler was a kind of Peter Pan. His famous farewell address of 1905, on the advantages of chloroforming people at sixty, was immediately characterized by Billings, in my hearing, as "one of Osler's jokes." Just before his departure for Oxford, I heard Osler say that to receive many LL.D's was equivalent to being laid on the shelf. What he called his "splintery and illogical mind" was, in fact, the Celt-Iberian in him, his defensive reaction against boredom. This mental dualism is particularly prominent in the dispute ever going on in his mind as to the futility of set examinations for medical students. He favored the military method of estimating a man day by day, for "corrective action," with "finals" as a mere confirmatory test. Due to his unfortunate training under Bastian, the coryphaeus of "spontaneous generation," Osler was slow to think bacteriologically, and did not sense the value of Pasteur's and Laveran's discoveries as swiftly as Sternberg or Councilman; but once convinced (*e.g.*, after making 70 separate blood-tests), he stacked up nobly.

An impression seems to prevail among some younger men, that Osler's career was a mere effect of personality, as with such clinical actors as Dieulafoy. This is silly. Osler described the main features of four relatively unknown diseases and added vastly to the clinical minutiæ which are finally absorbed in text-books. In many meetings and conversations, I never once heard him refer to these things, otherwise buried by the poor indexing of his book on Practice. I know of great professors who have selfishly assimilated their pupils' ideas and inventions without a word of credit. That was not Carl Ludwig's way, nor was it Osler's. I personally know that when a book of mine was announced for publication, Osler deliberately held up his Lowell lectures on the same subject (then in type) and they were not published until after his death. That was his generous, self-effacing way with younger men. We shall not fail to keep his memory green and his spotless reputation from assoil.

A fair slant on Osler's character is afforded by his innate aversion to "Jedburgh justice" even toward the enemies of his country. There was in him much of the *"tout comprendre, c'est tout pardonner"* of the priest, the tendency "to ignore, to disdain, to consider, to overlook" which William James regarded as "the essence of the gentleman." When Edward Dowden's mawkish life of Shelley appeared, a great clatter about the unfortunate poet's failings was stirred up by Matthew Arnold's moralizing critique and the dreadful effusions of those arch-Philistines, Charles Dudley Warner and the later Mark Twain. When some one brought up the subject casually in the Surgeon General's Library, Osler said curtly and sadly, "Shelley has been well hanged!" and left the building abruptly without saying adieu. I feel sure that his sentiments were those of Swinburne: *"Otez à Shelley sa foi sublime, son dévouement héroïque, son amour du droit et de l'idéal, il sera toujours un des plus grands poètes de tous les siècles."* During the war, Osler's attitude was that of a first-class military man—the impersonal "hostile view" rather than the hysterical "hostile feeling" of the hymns of hate. In 1915, he wrote to Wenckebach in Vienna: "How interesting for you to be a follower

of your great countrymen, van Swieten and de Haën!" The end of the war found him tolerant and helpful toward starving enemy colleagues, and no proof of gratitude more touching than the laurel wreaths which Sudhoff, Wenckebach and Friedrich Müller laid upon his grave.

F. H. GARRISON
ARMY MEDICAL MUSEUM
WASHINGTON, D. C.

SPECIAL ARTICLES

ON THE X-RAY DIFFRACTION EFFECTS FROM SOLID FATTY ACIDS

X-RAY diffraction effects have been obtained from solid films of numerous fatty acids and other long-chain carbon compounds.[1] These films have been made by allowing the molten substance to solidify on a glass or mica plate. The reflection photographs from such a preparation are not powder patterns, but they have as their conspicuous feature a series of several orders of an exceptionally large spacing.

It has sometimes been imagined that certain solids possess a regularity of molecular arrangement in only one or two dimensions. Such "smectic" substances[2] would thus be intermediate between crystals on the one extreme and amorphous solids on the other. The single reflections (and their higher orders) observed from various fatty acids and other long carbon-chain compounds have been cited[3] to show that they are such "smectic" substances. This conclusion has been doubted, however, by others.[4] From a different point of view, also, X-ray diffraction from the long carbon-chain solids is of interest. In the past the relatively short interplanar distances in such crystal gratings as calcite or gypsum have set a definite limit beyond which the X-ray spectrographs could not go in studying radiation. The much greater spacings (up to about 60A) found from these organic compounds, however, open up a correspondingly long wave-length range to direct investigation.

Several fatty acids have consequently been studied with the two fold purpose (1) of throwing light upon their possibly "smectic" nature and (2) of finding means of preparing them in the form best suited to their use as X-ray gratings. Most of the work happens, however, to have been carried out upon palmitic acid and, unless otherwise stated, these results refer to this particular long-chain compound.

It has recently been stated[5] that stearic acid is truly crystalline. The following experiments seem to show definitely that palmitic acid also is crystalline at ordinary temperatures. If a small amount of the pure acid is melted between two glass plates and cooled in such a way that solidification proceeds from a single point outwards, large areas of the resultant film prove on microscopic examination to have a common optical orientation. Fairly good interference figures are produced by these patches. An X-ray reflection photograph from such an acid film shows very strongly the characteristic several orders of large spacing, together with a few somewhat hazy lines from the more usual short spacings. If, on the other hand, crystallization is allowed to start at many points during the preparation of the solid film, the areas of optical homogeneity are greatly diminished in size. Such a film may be prepared by rapid cooling and is most readily obtained if the acid is not quite pure. In extreme cases the X-ray reflection photograph from such a film will show little or no evidence of the long spacing reflections. In their place appear several hazier lines of the sort typical of a powder photograph. This powder character is confirmed by the fact that the resulting photograph is substantially the same when the acid film is rotated as when it is held stationary in two arbitrarily placed positions. Similar photographs showing predominant powder reflections have also been made from impure erucic and, less easily, from fairly pure lauric acid.

Palmitic acid, in common with numerous other compounds of this class, can be obtained in flakes from various organic solvents. By cooling an acetone solution in a sealed tube, we have obtained single, very thin plates a centimeter across. These plates give good interference figures. Such flakes from acetone and from α-monochloronaphthalene are diamond-shaped with the interior acute angle 56°. They are biaxial with +2V small, and with the optic axial plane apparently normal to the plane of the flakes and bisecting the acute angle. The acute bisectrix is inclined about 40° to the plane of the flakes. The refractive indices are: $\alpha = 1.495$, $\beta = 1.507$, $\gamma = 1.58$. Reflection spectrum photographs from one of these plates show the several orders of the large spacing with extraordinary intensity. Apparently on account

[1] M. de Broglie and E. Friedel, Compt. rend. *176*, 738 (1923); A. Müller, *Trans. Chem. Soc.* (London) *123*, 2043 (1923); G. Shearer, *ibid.*, *123*, 3152 (1923); A. Müller and G. Shearer, *ibid.*, *123*, 3156 (1923); S. H. Piper and E. N. Grindley, *Proc. Phys. Soc. 35*, 269 (1923); R. E. Gibbs, *J. Chem. Soc.* (London) *125*, 2622 (1924).

[2] G. Friedel, *Ann. de Phys. 23*, 273 (1922).

[3] M. de Broglie and E. Friedel, *op. cit.*; E. Friedel, Compt. rend., *180*, 269 (1925).

[4] J. W. MacBain, *Nature, 113*, 554 (1924); *114*, 49 (1924).

[5] R. E. Gibbs, *op. cit.*

of the large solubility and temperature coefficient of solubility of palmitic acid in acetone, it has not yet, however, been possible to find on the single crystals removed from their solutions the small prism and pyramid faces necessary for a more detailed crystallographic study.

The results stated above are in agreement with the recently published statement[6] that the fatty acids, or some of them at least, form monoclinic crystals. They also do not conflict with other experimental results recently obtained[7] from palmitic acid. Inasmuch as these latter results are stated to be qualitatively of the same character as those furnished by the typical "smectic" compounds and since palmitic acid prepared under similar conditions shows all the expected reactions of a crystal towards X-rays and light, it seems necessary to conclude that as yet there is no X-ray diffraction evidence for the existence of "smectic" or other substances intermediate in molecular arrangement between true crystals on the one hand and amorphous substances on the other.

The fact that intense large spacing reflections are obtained from films of acid solidified on glass plates is probably not, as many seem to have supposed it to be, indicative of a close similarity between such films and oil films on water. In the latter case existing molceular orientation is to be attributed to a sort of chemical reaction between the water and one end of the oil molecules. In the solid acid films the glass backing is to be considered as chemically inert. These films are sometimes oriented because under appropriate conditions relatively few crystal nuclei are formed during solidification and the comparatively large individuals that result have the strongly platy habit characteristic of these crystals. It is in accord with such a view that working the solid films[8] increases the intensity of the long spacing reflections by making the platy crystals more nearly parallel to one another and to the glass sheets on which they are mounted. Graphite with a similar crystal habit behaves in the same fashion. It is also in accord with this view that the presence of other acids as impurities in the sample under investigation weakens the intensities of the large spacing reflections by multiplying the number of crystal nuclei and thereby interfering with the growth of the large oriented crystal plates. Because they melt nearer to room temperature it should be easier under the same conditions of cooling to make large-crystal films of the simpler fatty acids than of the more complex ones. In these experiments it has been found easier to make good films of capric and lauric acids than of those with much longer carbon chains.

The regular increase in the number of carbon atoms in the chain of these fatty acids and other long-chain compounds has been used to estimate the diameter of the carbon atom in these compounds.[9] This would of course be legitimate only in case the carbon chains were perpendicular to the reflecting plane. Our microscopic examination—in particular the behavior of the interference figures on rotation of the sample—shows clearly that no axis of symmetry is normal to this plane. It is therefore necessary to conclude that the long carbon chains are inclined at an angle to the reflecting face and that the increase in spacing with number of carbon atoms is not a simple and direct measure of carbon-to-carbon distances. The value of this angle can not be told in advance of crystallographic measurement. Furthermore, though apparently it changes in regular fashion in passing from acid to acid, this angle is very probably not the same for any two acids.

SUMMARY

Powder reflections, as well as single face reflections of large spacing, have been obtained from palmitic and other fatty acids. Single specimens with all the optical properties of a crystal and giving the same large spacing X-ray reflections as solidified films on glass have been grown from solution of palmitic acid in acetone. This acid, at least, therefore appears to be truly crystalline under these conditions and not in a "smectic" or other sub-crystalline state. Since the X-ray data from this acid are strictly analogous to those from other typical "smectic" substances, it seems necessary further to conclude that no definite X-ray evidence yet exists for this "smectic" state.

The symmetry of palmitic acid is either monoclinic or triclinic and the long carbon chains are not normal to the face producing the large spacing reflections. Such spacings are therefore not direct measures of the lengths of these chains.

By growing single plates of the acid from solution more intense reflections from the long spacings have been obtained than from films made by solidifying the acid on glass or mica. Such single crystals may prove especially useful as gratings in long wave length X-ray spectrography.

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[6] W. H. Bragg, *Nature*, *115*, 266 (1925).

[7] J. J. Trillat, Compt. rend., *180*, 280 (1925).

[8] W. H. Bragg, *op. cit.*

[9] A. Müller, *op. cit.*; G. Shearer, *op. cit.*

THE AMERICAN SOCIETY OF MAMMALOGISTS

THE seventh annual meeting of the American Society of Mammalogists was held at the U. S. National Museum in Washington, D. C., from April 7 to 11, 1925, with 78 members in attendance. The 31 papers presented during the morning and afternoon sessions were of an unusual order of excellence and included many of much popular as well as technical interest. Outstanding features were an illustrated evening lecture by President W. H. Osgood, entitled "On Darwin's trail in South America," and the presentation of "Vanishing game trails of Africa," a remarkable film secured by W. P. Harris, Jr. Moving pictures illustrated two of the other papers as well.

The annual dinner on April 9 was well attended, the feature of the menu being roast buffalo, while elk meat figured at the luncheon, two days later, which was tendered the members and their wives by the administration of the National Zoological Park and the Washington contingent.

At the usual directors' and business meeting the following officers were elected: *President,* Wilfred H. Osgood; *vice-presidents,* W. D. Matthew, Glover M. Allen; *recording secretary,* H. H. Lane; *corresponding secretary,* A. Brazier Howell; *treasurer,* Arthur J. Poole; *editor,* Hartley H. T. Jackson.

During the session the following resolution was adopted:

WHEREAS, Plans have been made for introducing large numbers of Plains Buffalos annually into the Wood Buffalo Park of northern Alberta, and

WHEREAS, The American Society of Mammalogists, a professional society of international membership, including practically all field naturalists who are interested in mammals, feels that serious results would occur from carrying out the above-mentioned plans, *viz.*:

(A) Interbreeding would take place between the races of the Plains Buffalo and Wood Buffalo so that the distinctive characteristics of the Wood Buffalo would be lost in a few generations and in this way the largest and noblest game animal of North America would pass out of existence as such.

(B) The new arrivals and mixed descendants of the two races of buffalo would be less fitted to carry on the struggle for existence in northern Alberta than is the native race of Wood Buffalo.

(C) Tuberculosis and other diseases would be likely to be transmitted with harmful effects to the northern herd.

(D) Owing to the restricted range of the Wood Buffalos and the limited amount of food available, overcrowding would follow so that the proposed plan would afford only a temporary means of disposing of the surplus of Plains Buffalos: therefore, be it

Resolved, That the American Society of Mammalogists express its earnest hope that some other means may be found of disposing of the surplus Plains Buffalos, and, be it further

Resolved, That copies of this resolution be forwarded to the Department of the Interior of Canada and to the organizations interested in wild-life conservation.

The meeting for 1926 will be held during April at the American Museum of Natural History in New York City.

A. BRAZIER HOWELL,
Corresponding Secretary

WASHINGTON, D. C.

THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-third western meeting of the American Mathematical Society was held at the University of Chicago on April 10 and 11, 1925.

The council elected to sustaining membership Amherst College, Harvard University, the Maccabees, the Missouri State Life Insurance Company, the Pacific Mutual Life Insurance Company, the Prudential Insurance Company and the Travelers' Insurance Company. Eleven persons were elected to ordinary membership and twenty nominees of sustaining members were elected. It was announced that through the efforts of the committee on endowment, the society now has four patron members and twenty-nine sustaining members.

The summer meeting and colloquium will be held at Cornell University from September 8 to 12. Colloquium lectures will be given by Professor L. P. Eisenhart on "The new differential geometry" and Professor Dunham Jackson on "The theory of approximation." The western Christmas meeting of the society will be held in Kansas City in conjunction with the meetings of the American Association for the Advancement of Science. One of the features of this meeting will be the third Josiah Willard Gibbs lecture by Professor J. Pierpont, of Yale University, on "Some modern views of space."

On Friday afternoon Professor W. D. MacMillan, of the University of Chicago, delivered a lecture on "Some mathematical aspects of cosmology." The other papers presented at this meeting are listed below. The papers by Messrs. Reilly, Bennett, Caris, Shohat and Wilson and Mr. Ingraham's second paper were read by title. The sessions were presided over by President Birkhoff and Vice-president Hildebrandt.

Cubic curves and desmic surfaces: R. M. MATHEWS.

Another poristic system of triangles: RUFUS CRANE.

A general theory of nets on a surface: V. G. GROVE.

On surfaces and curves which are invariant under involutory Cremona transformations: ARNOLD EMCH.

Mean curvature curves on quadric surfaces: E. E. LIBMAN.